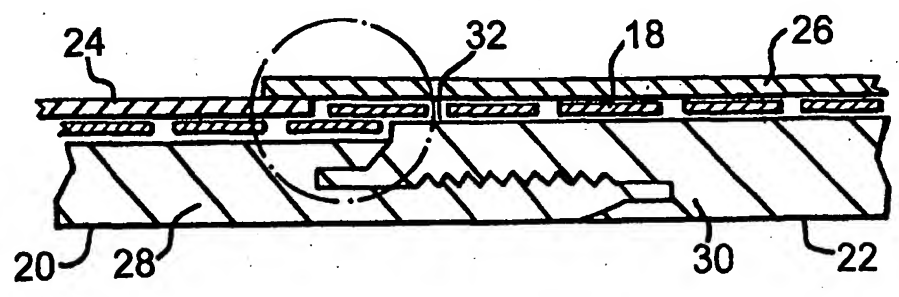


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<b>(21) International Application Number:</b> PCT/GB99/02605 <b>(22) International Filing Date:</b> 9 August 1999 (09.08.99) <b>(30) Priority Data:</b> 9817246.3      8 August 1998 (08.08.98)      GB <b>(71) Applicant (for all designated States except US):</b> PETROLINE WELLSYSTEMS LIMITED [GB/GB]; Offshore Technology Park, Claymore Drive, Bridge of Don, Aberdeen AB23 8GD (GB). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> METCALFE, Paul, David [GB/GB]; North Wing, Bucklerburn Steading, Peterculter AB14 0NP (GB). <b>(74) Agents:</b> MCCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Square, Glasgow G1 3AE (GB).		<b>(81) Designated States:</b> AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i>
<b>(54) Title:</b> CONNECTOR FOR EXPANDABLE WELL SCREEN		
		
<b>(57) Abstract</b> <p>A tubing connection arrangement (10) comprises two expandable tubing sections (12, 14), each tubing section comprising a filter screen (16, 18) sandwiched between inner expandable tubing (20, 22) and outer expandable tubing (24, 26). The filter screen of one tubing section overlaps the filter screen of the other tubing section and the outer expandable tubing of at least one of the tubing sections extends over the overlapping filter screens. On expansion of the tubing sections, the overlapping filter screens, restrained by the outer tubing, ensure the integrity of the filter between the tubing sections.</p>		

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## CONNECTOR FOR EXPANDABLE WELL SCREEN

This invention relates to a downhole connector, and in particular to an arrangement for ensuring the integrity of a sand screen or other filter medium at a connection between two lengths of expandable tubing utilised to support or form a sand screen or filter.

In many well bores where a liquid, for example oil, passes from a surrounding formation into the well bore, the liquid will often carry entrained sand particles. If this sand is permitted to pass into the well bore a number of problems may arise, including an increased likelihood of the well bore becoming blocked or restricted, and the sand may cause downhole tools to stick or jam, or wear prematurely. Accordingly, it is preferred that the sand particles are retained in the formation. This is achieved by providing screens or a filter around the casing or production tubing.

International Patent Application WO 97/17524 (Shell), the disclosure of which is incorporated herein by reference, describes a radially expandable assembly in which overlapping filter sheets are sandwiched between inner expandable support tubing and outer expandable protective tubing, the expandable tubing featuring large numbers of overlapping longitudinal slots. When an expander cone is forced through the assembly, the inner and outer tubing is expanded radially, the slots extending to form diamond-shaped openings. The initial degree of overlap between the screens is selected such that,

although the screens move circumferentially relative to one another during expansion, the edges of the screens remain in overlapping relation. Such an arrangement can easily be constructed over sections of plain tubing or pipe. However, at the connections between tubing sections, where the inner tubing sections are coupled together, it is difficult to maintain a "sand-tight" join.

It is among the objectives of embodiments of the present invention to provide a connector arrangement which obviates or mitigates this difficulty.

According to the present invention there is provided a connector arrangement for provision between the ends of two sections of expandable tubing, each expandable tubing section comprising a filter screen sandwiched between inner expandable tubing and outer expandable tubing, the filter screen of one tubing section overlapping the filter screen of the other tubing section and the outer expandable tubing of at least one of the tubing sections extending over the overlapping filter screens.

The invention also relates to expandable tubing sections which are adapted to be connected in this manner, and to expandable tubing strings incorporating such connector arrangements, and to a method of connecting tubing sections.

On expansion of the tubing sections, the overlapping filter screens, restrained by the outer tubing, ensure the integrity of the filter between the tubing sections.

The outer expandable tubing of one tubing section may be arranged to overlap or to butt against the outer expandable

tubing of the other tubing section.

Each filter screen will typically comprise a plurality of overlapping plates, sheets or membranes individually mounted to the respective inner expandable tubing by axially parallel connectors or fixings, such as screws, lugs or welds.

Preferably, the filter screens of each tubing section are initially radially spaced apart to facilitate make-up of the connector. However, on expansion, the resistance of the outer tubing to radial expansion of the inner tubing ensures that the outer filter screen is pressed into sand-tight engagement with the inner filter screen. The desired relative positioning of the filter screens of the two tubing sections may be achieved by providing one inner tubing section having an end of slightly larger diameter than the other. In certain embodiments the ends of each tubing section may be upset, that is of greater diameter than the remainder of the tubing section, and the desired difference in diameter may be achieved by providing a slightly higher upset on one tubing section. Conveniently, the inner tubing sections will feature pin and box connections, and the upset on the box may be slightly higher than the pin. Of course the opposite arrangement may be provided, that is the pin upset being higher than the box.

The ends of one or both filter screens may be provided with means for preventing interference between the screen ends when the tubing sections are rotated relative to one another, as may be the case if the tubing sections are

threaded to one another. Said means may take the form of a sleeve of flexible or extendible material located internally and/or externally of the filter screens. The sleeve may be formed of flexible slotted tubing, plastics, rubber, wire mesh or wire composites.

According to another aspect of the present invention there is provided a section of expandable tubing comprising a filter medium sandwiched between inner expandable tubing and outer expandable tubing, the filter medium comprising a plurality of circumferentially extending filter sheets, each sheet being coupled at one edge to one of the inner and outer tubing and having the opposite edge overlapping an adjacent sheet, and means for reducing the friction between at least one of the filter sheets and the filter sheets and the tubing.

In other aspects of the invention friction reducing means may be provided on other parts or elements of a tubing section.

This aspect of the invention may be provided in combination with the first described aspect.

In use, the friction reducing means facilitates expansion of the tubing by facilitating relative circumferential movement of the filter sheets relative to one another and of the filter sheets relative to the tubing. The presence of such friction reducing means also reduces the likelihood of damage occurring to the relatively fragile filter sheets during expansion, as has been found to occur on occasion in tubing made in accordance with WO 97/17524.

Preferably, the friction reducing means is a low

friction coating applied to the filter sheets, such as a PTFE-based material such as Teflon (trade mark). In other embodiments a friction-reducing lubricant, such as high temperature grease, may be provided. Alternatively, sheets of low friction material may be placed between the filter sheets and the tubing.

These and other aspects of the present invention will now be described, by way or example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic sectional view of part of a connector in accordance with a preferred embodiment of the present invention, with the connector parts shown separated; and

Figure 2 is a schematic sectional view of the connector of Figure 1, with the connector parts shown coupled together.

The drawings illustrate part of a connector 10 in accordance with an embodiment of the present invention. The connector 10 is provided between the ends of two sections of expandable tubing 12, 14, each comprising filter plates 16, 18 sandwiched between inner expandable support tubing 20, 22 and outer expandable protective tubing 24, 26. Each section of expandable tubing 20, 22, 24, 26 defines a large number of longitudinal overlapping slots. The sections of inner or base expandable tubing 20, 22 are formed with co-operating pin and box connections 28, 30, to allow the tubing sections 12, 14 to be made up by relative rotation.

As is more clearly apparent from Figure 2, the box connection 30 is upset from the pin 28. The filter plates 18

